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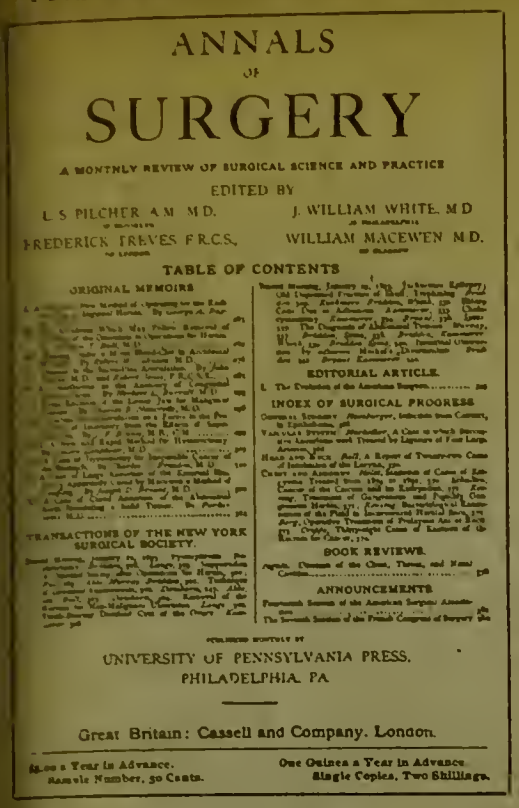
ANNALS
OF
SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

EDITED BY

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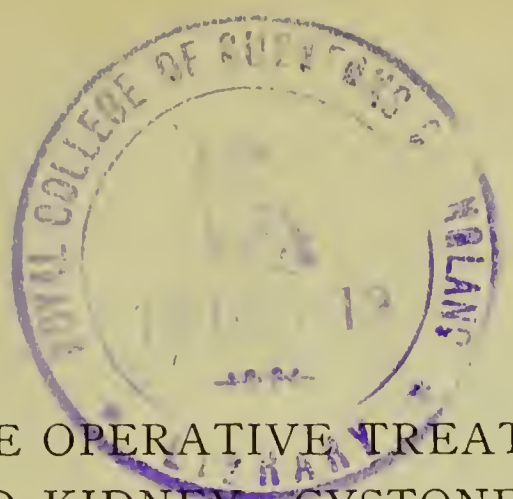
CONSERVATIVE OPERATIVE TREATMENT OF SACCULATED KIDNEY—CYSTONEPHROSIS.

By CHRISTIAN FENGER, M.D.,

OF CHICAGO.



CONSERVATIVE OPERATIVE TREATMENT OF SACCULATED KIDNEY—CYSTONEPHROSIS.[1]

By CHRISTIAN FENGER, M.D.,

OF CHICAGO.

DILATATION of the urinary passages (cystonephrosis, Küster) above a stenosis or occlusion presents remarkable variations according to the character of the pathological conditions which cause the retention of urine above it.

A sudden, complete, acute occlusion of a ureter, as shown by Cohnheim and others experimentally by ligature of the ureter in animals, is followed by only a temporary, medium degree of dilatation above, of the ureter, pelvis, and calyces, often followed by absorption of the urine, atrophy of the kidney, and final transformation of the latter into a small mass of cicatricial tissue, with or without small cysts, from which a dilated, normal-sized, atrophic, or even obliterated ureter leads down to the original place of occlusion.

It requires a slowly-developing, incomplete, or intermittent obstruction for the development of a permanent dilatation of the kidney, a hydronephrosis containing an aseptic fluid, or a pyonephrosis containing an infected fluid,—pus.

Incomplete obstructions caused by pressure on the ureter from without by many different pathological conditions, or by obstruction within from stones, valves, or strictures, do not come within the scope of this paper.

Obstruction by bending and valve-formation at the pelvic end of the ureter, or oblique insertion of the latter on or in a dilated pelvis, has been studied carefully by Simon,[2] and since his

[1] Reported before the Surgical Section of the College of Physicians of Philadelphia, May 10, 1895, and before the Chicago Medical Society, December 2, 1895.

[2] Simon, Chirurgie der Nieren, Vol. II, Stuttgart, 1876.

time by many investigators, Tuffier, Landau, Terrier, Fenger, and others, so that this condition is comparatively well understood at the present time, and the surgical means of treatment in a fair way of development.[1]

Obstruction above the ureter—that is, in or above the pelvis of the kidney, with the exception of those cases in which stones in the pelvis or calyces cause retention and dilatation above—has not been studied, and little attention has been paid to this condition, in all probability because the kidney in these cases has been removed, either by primary nephrectomy or, when a permanent urinary fistula has followed nephrotomy, by secondary nephrectomy at an earlier or later period.

The dawning conservatism in the surgery of the kidney has naturally led to the attempt to save all the "noble tissue of the kidney," as Tuffier terms it, that may still be of use to the organism. It is consequently important to study these obstructions in detail with the hope that we may be able to recognize and, perhaps, find means to remedy the stenosis, instead of sacrificing the organ.

I have found that a non-calculous obstruction may take place in or rather above the pelvis in a similar manner to that which occurs at the pelvic end of the ureter, and for this reason I shall call attention to some points in the pathology of the latter condition.

Valve-formation at the pelvic end of the ureter is always combined with bending or oblique insertion of the ureter in the dilated pelvis, and often with stenosis or stricture of that portion of the ureter which is located in or on the pelvic wall.

I shall first consider the bending or oblique insertion of a non-stenosed ureter. How does this condition develop?

Cohnheim[2] regards it as a congenital anomaly, "Bildungsfehler."

Landau[3] and Terrier believe that the bending is originally caused by descent of a movable kidney. Landau has seen, on

[1] Fenger, Journal of the American Medical Association, March 10, 1894.

[2] Cohnheim, Allgemeine Pathologie, Band II, p. 403.

[3] Landau, Berliner klinische Wochenschrift, No. 18, 1888, p. 366.

the cadaver, that the ureter bends at its pelvic orifice when the kidney is pulled down, because the ureter at this point is held against the posterior abdominal wall by strong connective tissue, and does not follow the moving kidney. He further states that hydronephrosis with patent ureter is more frequently seen in women and on the right side, consequently, under the circumstances, most favorable for a pre-existing movable kidney.

Tuffier[1] was the first to establish conclusively, by a series of beautiful experiments and by careful clinical observations, the exact causal relation between floating kidney and cystonephrosis. He found that when a kidney was made movable, bending of the ureter would take place in more than one-half of the cases, usually a few centimetres below the pelvis, the bend being either angular or sigmoid; this would give rise to gradual obstruction and dilatation above the bend. The cystonephrosis is at first remittent as long as the bend can be straightened, but, later on, as shown in the clinical observations, becomes permanent.

The results of these experiments correspond so well with the clinical manifestations of intermittent hydronephrosis that Tuffier considers nephrorrhaphy sufficient to establish a cure in the majority of these cases. This opinion is based upon nine operations, all of which were successful. In all these cases the kidney was movable.

Simon[2] believes that temporary obstruction from any cause may produce sufficient asymmetrical dilatation of the renal pelvis to give rise to twisting of the kidney on its longitudinal axis, leading to bending, oblique insertion, and valve-formation.

Küster[3] considers the primary cause to be pyelitis; the inflammation causes swelling of the mucous membrane in the ureter and pelvis, the swelling causing relative stenosis and increased pressure from the urine above. This pressure causes

[1] It is self-evident that nephrorrhaphy can be useful only when the bending and valve-formation caused by the mobility of the kidney are not complicated by stenosis, and it may be difficult to be sure of this condition without opening the pelvis or ureter.

[2] Simon, Op. cit.

[3] Küster, Ueber die Sackniere,—Cystonephrosis, Deutsche medicinische Wochenschrift, Nos. 19 to 22, 1888, p. 369.

prolapse, invagination, or folding of the movable mucosa, at or above the pelvic orifice, down against or into the narrower ureter, and thus produces an effective, even if only temporary, obstruction.

Israel,[1] reported by Rosenstein, takes issue with Küster, and states that oblique insertion and valve-formation are often found in perfectly aseptic hydronephroses where pyelitis has not previously existed. (Landau and others.)

All the opinions which have been cited above undoubtedly have their legitimate place and part in the causation of cystonephrosis.

I think that Simon is correct in laying greatest stress upon the asymmetrical dilatation of the pelvis caused by temporary obstruction of whatever origin. Thus a temporary pyelitis (Küster) may lead to a moderate pyonephrosis which is made permanent and progressive by subsequent valve-formation. Furthermore, a movable kidney (Tuffier, Landau, and Terrier) may lead to bending of the ureter, causing a temporary obstruction, followed by asymmetrical dilatation of the pelvis and oblique insertion, and this condition subsequently leads to a progressive aseptic hydronephrosis.

My reason for considering the asymmetrical dilatation caused by slight, temporary obstruction as the main factor in the development of valve-formation is that I have found that temporary obstruction causing valve-formation above the pelvis was followed in a case of pyelitis by a septic cystonephrosis (pyonephrosis), and that in another case, after compression of a ureter from without by a perityphlitic exudate, an aseptic cystonephrosis (hydronephrosis) followed.

I will illustrate the asymmetrical dilatation above referred to by the following figure (Fig. 1), which shows unilateral, asymmetrical dilatation of a canal or tube. The dotted lines a^1 to a^5 represent the increasing dilatation of one side of the wall of the ureter b. Pressure from the contents in the dilated portion will act upon the wall of the tube at d, and will press the upper free end c over against the opposite wall at c^1. Thus

[1] Israel, Berliner klinische Wochenschrift, No. 18, 1888.

it is evident that, upon a certain degree of pressure from fluid in the dilated space, this unilateral dilatation will result in closure of the tube.

The fact that the ureter is ordinarily a narrower tube than

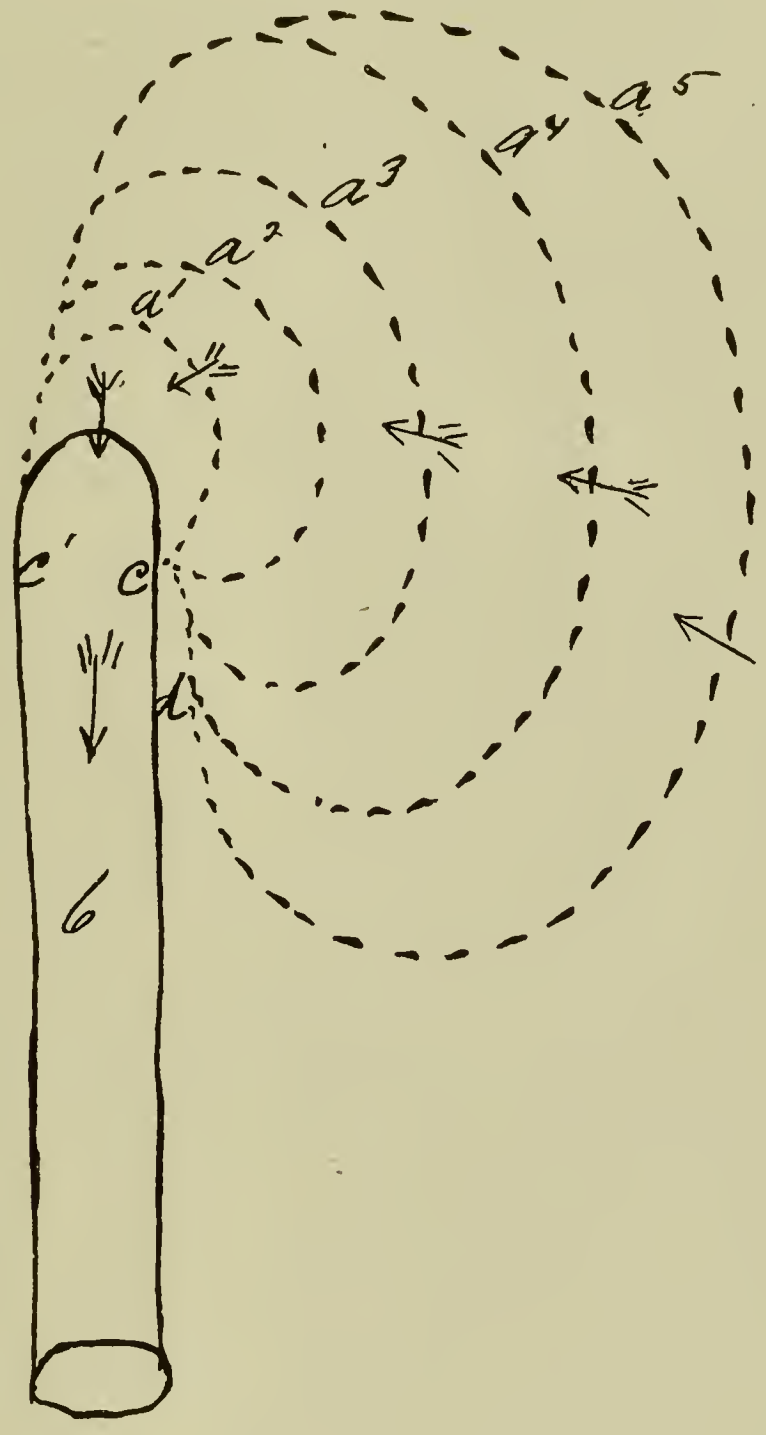


FIG. 1.—Causation of asymmetrical dilatation of a canal or tube (diagrammatic).

the pelvis is immaterial, it even may facilitate the oblique insertion from unilateral dilatation of the pelvis.

In considering occlusion above the pelvis, it is well to remember the variations in the upper end of the ureter, as pointed

out by Hyrtl.[1] In the first variety there is no pelvis, but the ureter divides into two branches without dilatation at the point of division, each branch having a calibre a little larger than that of the ureter. In the second variety there is a pelvis,—that is, a funnel-shaped dilatation at the point of division. The upper portion is the smaller and terminates in three short calyces; the lower and more voluminous portion terminates in four or five calyces. In the third variety there is only half a pelvis,—that is, the lower branch divides and is funnel-shaped, forming a narrow pelvis which terminates in one, two, or three short calyces; while the upper is not dilated and extends to the upper portion of the kidney as a continuation of the ureter. The ureter not uncommonly divides far below the kidney, between the kidney and the bladder; sometimes there is no division at all, and two separate ureters enter the bladder.

Unilateral dilatation and valve-formation may take place in any canal in the body,—biliary passages, œsophagus, intestinal tract,—and inasmuch as not only each branch of the ureter, but also the neck of each of the calyces is a canal, any of these may become the seat of this anomaly. If one of the two main branches of the ureter becomes the seat, retention occurs in the corresponding territory,—that is, in the upper or lower half of the kidney. As the branch to the upper portion of the kidney runs in a straight direction, while the branch to the lower portion goes off at a right angle, the latter portion will probably be more liable to this condition, and, in fact, in both of my cases and in Rayer's obstruction from stone and Israel's, four cases in all, the lower branch was involved. I have not seen or found in the literature any instance of this anomaly in the upper branch. When, on the other hand, the unilateral dilatation begins at the neck of a single calyx, the retention will be limited to the territory of this calyx. It will thus be seen that valve-formation takes place independent of any rotatory movement of a dilating kidney Simon), and that unilateral dilatation is the only condition necessary to this development.

While valve-formation and retention in one of the branches

[1] Hyrtl, cited from Henle's Handbuch der systematischen Anatomie.

of the ureter are probably very rare,—as partial or local hydronephrosis is very rare, seven cases only,—valve-formation and retention at the neck of a single calyx is, I believe, relatively common.

In Rayer's Atlas [1] a number of kidneys with this condition are illustrated, and in my case of pyonephrosis I found not less than three calyces in this condition.

Fig. 2 illustrates schematically unilateral dilatation and valve-formation, at *a*, in the lower branch of the ureter, where the free end of the valve, at *a*, is pushed over to *a'*, and dilatation of a single calyx at *b*, where the end of the valve at *b* is pushed over to *b'*, causing occlusion.

Dilatation of one-half of the kidney, local or partial cystonephrosis, may thus be caused by gradual occlusion of the lower branch of the ureter in the hilus of the kidney (Rayer one case, Israel one case, Fenger two cases), or it may be caused by occlusion of one of the divisions of an anomalous double ureter, as in two cases described by Heller [2] and in one described by Valter.[3]

The first case on record of valve-formation in the lower branch of a ureter causing hydronephrosis was observed by me in 1872 when I was prosector in the Kommunehospital, in Copenhagen.[4]

The patient was a man of twenty, who had, in August, 1872, an attack of perityphlitis, or what is now known as appendicitis, followed several months later by a fluctuating swelling, the size of an orange, in the region of the right kidney. This dilatation was intermittent, as it would disappear suddenly and reappear a few weeks later. Besides this tumor another swelling gradually developed above and below Poupart's ligament, and hectic fever set in. When the patient entered the hospital, two distinct fluctuating swellings were discovered, one up under the liver and the other in the iliac fossa, in contact with each other, but with a distinct groove between them.

[1] Rayer, P., Traité des Maladies des Reins, Paris, 1837.

[2] Heller, Deutsches Archiv für klinische Medicin, Band v, 1869, p. 267 ; Ibid., Band vi, p. 276.

[3] Valter, cited from Heller.

[4] Fenger, Om den partielle Hydronefrose, oplyst ved et Sygdomstilfälde, Nordiskt Medicinskt Arkiv, Band v, No. 12, 1872.

Exploratory aspiration of the upper tumor evacuated 2000 cubic centimetres of urine, which had a specific gravity of 1007, contained four-tenths of 1 per cent. of urea and no uric acid. The upper tumor disappeared after puncture. Five days later the lower tumor was aspirated and 500 cubic centimetres of fetid pus evacuated. The patient died two weeks later of pyæmia.

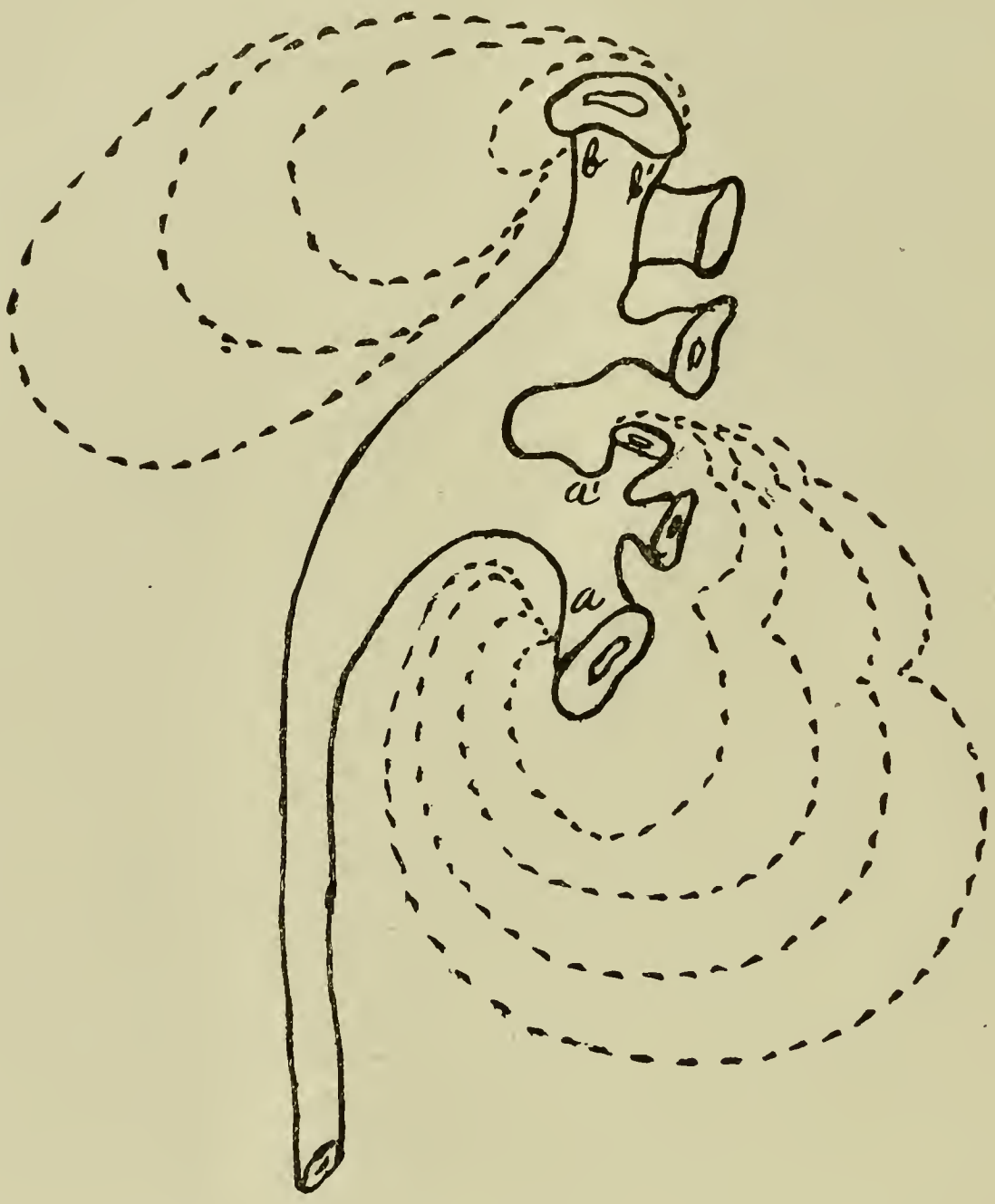


FIG. 2.—Development of unilateral dilatation and valve-formation of the lower branch of the ureter and of a calyx (diagrammatic).

The autopsy revealed septic infarctions and abscesses in both lungs, a large perityphlitic abscess around the cæcum and lower ileum, extending through the iliac fossa down upon the femur. The patient consequently died from pyæmia, following what would now be called appendicitis. The left kidney, ureter, and the bladder were normal.

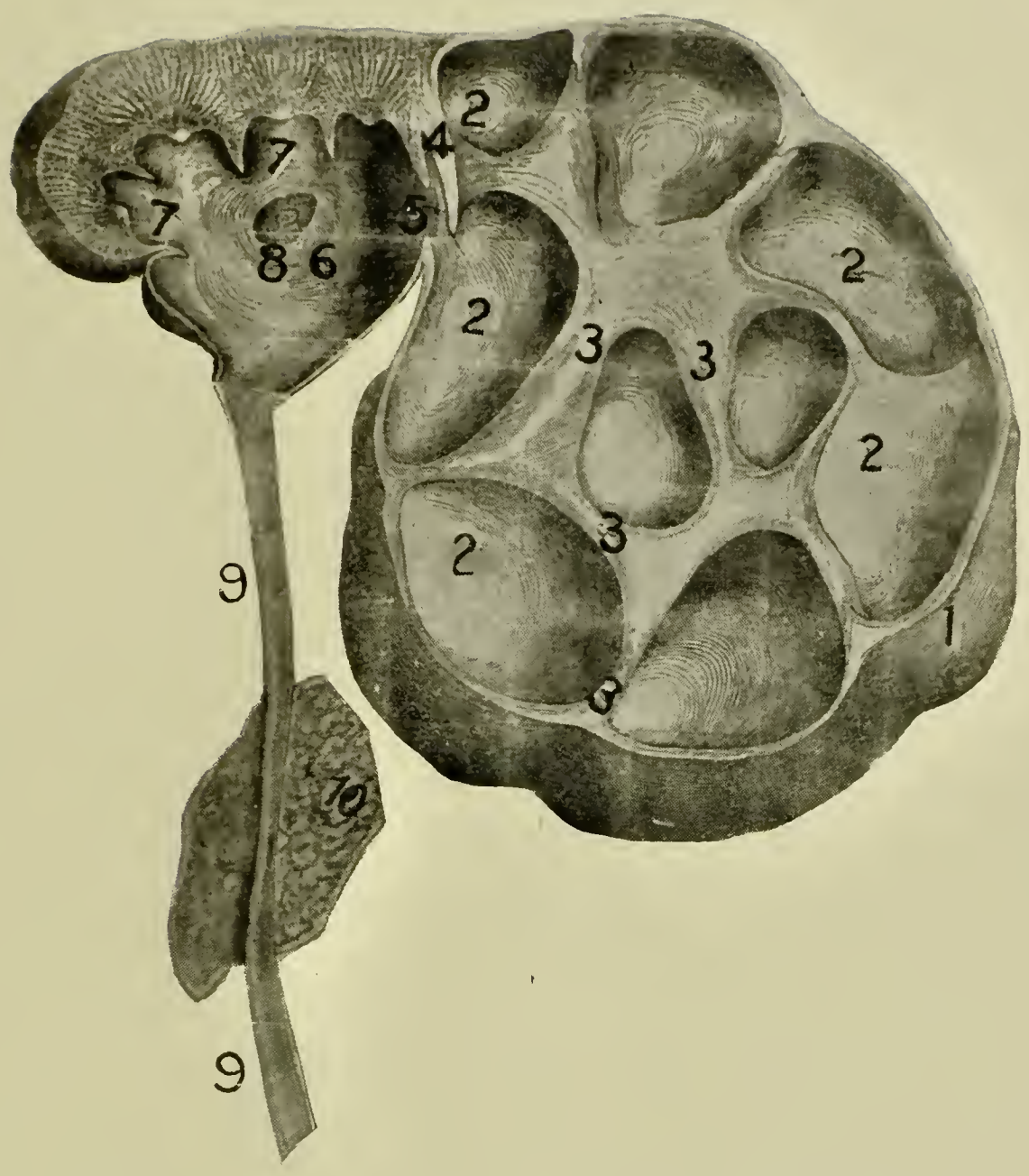


FIG. 3.—Vertical section through a right hydronephrosis with valve-formation, and through kidney and ureter. (One-half normal size.)

1. Hydronephrotic sac.
2. Cavities of dilated calyces surrounded by
3. Semilunar partition walls, one of which forms
4. The valve which covers from below and closes
5. The opening up into
6. The somewhat dilated upper branch of the ureter, —that is, the pelvis of the upper two-thirds of the kidney.
7. Calyces.
8. Entrance to a calyx from the pelvis.
9. Ureter somewhat narrowed or compressed in its course through
10. The perityphlitic abscess.

The right ureter passed through the perityphlitic abscess and was somewhat narrowed in this territory, but still admitted a grooved director. Pressure on the upper half of the kidney and the somewhat dilated pelvis caused urine to pass without difficulty down through the ureter. Pressure, however, on the hydronephrotic sac of the lower half of the kidney did not result in the passage of a drop of fluid. The ureter above the perityphlitic abscess was slightly dilated and led up to a pelvis dilated to the size of a hen's egg. This pelvis belonged to the upper two-thirds of the kidney. In this part of the kidney the kidney tissue was slightly compressed, as the papillæ were somewhat flattened and the pyramids shorter and broader than normal, while the cortical substance was of normal thickness. The kidney tissue in this locality was healthy with the exception of two septic infarctions the size of peas.

The lower third of the kidney was occupied by a large hydronephrotic tumor, a thin-walled multilocular sac, the size of a child's head, which contained 750 cubic centimetres of light-yellow, clear fluid. On its posterior wall was the puncture-opening surrounded by ecchymoses, and close to this point was a fresh coagulum, the size of a walnut. The upper, posterior portion of the sac, which was in connection with the kidney, showed a round opening one centimetre in diameter leading up into the pelvis of the upper two-thirds of the kidney. This opening was covered by a valve five centimetres broad and one and a half centimetres high, which hung over the opening like an upper eyelid, and closed it when the sac was filled with fluid. When, on the other hand, fluid was injected into the pelvis through the ureter, it opened the valve and opened and filled the hydronephrotic sac. The valve was semilunar and was formed by the partition wall between two calyces. The inner wall of the sac was smooth and showed an inner layer of atrophic kidney tissue one-half to one millimetre in thickness, in which only a few uriniferous tubules and glomeruli were visible upon microscopical examination. The outer layer was two to three millimetres thick, and was composed of firm connective tissue.

It is evident that the valve-formation in this case, which was located in the lower branch of the ureter, had for its primary cause the incomplete and temporary compression of the ureter by the perityphlitic abscess. This led to moderate dilatation of the ureter and of both of its branches. The valve-formation in the lower branch then followed as a secondary effect, and

this gave rise to a gradually-increasing, intermittent hydronephrosis of the corresponding lower third of the kidney. This hydronephrosis remained uninfected despite the pyæmia, because there was no pre-existing infection of the mucosa of the urinary tract.

That an entirely similar valve-formation may take place from temporary obstruction caused by pyelitis, which may lead to a similar partial cystonephrosis, but, as we would naturally expect, with infection of the contents and consequent formation of a pyonephrosis, is well illustrated in the following case, in which valve-formation occurred in all of the three places which I have pointed out above as the seat of this condition,—namely, the ureteral end of the pelvis, one of the two branches of the ureter (in this case again the lower branch), and at the necks of the calyces, in one of which the occlusion was complete.

Synopsis.—Gonorrhæa, May 29, 1893, followed by posterior urethritis. Renal colic on right side, November 7. Tumor in right kidney, November 20. No colic from December 7 to March 4, 1894. Colic from March 8 to 11; large tumor; high fever. Lumbar nephrotomy March 11. Three weeks later, about 250 small, round stones, the size of a shot, passed through the fistula; complete obstruction of ureter from right kidney for eight days. Ureter then open for ten days, proven by injection of pyoktanin. March 30, ureter again closed; lumbar renal fistula discharges thirty ounces in the twenty-four hours. September 16, operation for oblique implantation and stricture of pelvic end of ureter; persistence of urinary fistula secreting twenty-five ounces in twenty-four hours. January 22, 1895, sudden attack of colic from pyelitis in left kidney, lasting for two weeks. April 13, operation for sacculated right kidney; bisection of kidney. During the summer of 1895 one-eighth of the urine passed through ureter, seven-eighths through the lumbar fistula. August 17, operation for reunion of bisected kidney. September 17, three-fourths of the urine passed into the bladder. November 30, 1895, fistula closed. Fistula reopened January 5, 1896, and finally closed January 15.

Case I.—Mr. D'O. H., a medical student, twenty-one years of age, consulted me on June 22, 1894. Family history negative; no tuberculosis in family. Patient had the ordinary diseases of childhood.

On May 29, 1893, he contracted gonorrhœa, which ran a some-

what typical course. A month later, as a result of excessive exercise, intemperance and neglect, he suffered intense pain of a spasmodic character at the neck of the bladder on micturition. This was diagnosed as inflammation of the neck of the bladder, and persisted until August. From this time on there was no pain in the bladder or on micturition, but a slight discharge from the urethra continued until November 10.

On November 7, while in Philadelphia, pursuing his studies, he had a sudden severe attack of right renal colic which lasted seven hours. Examination of the urine at this time revealed marked hæmaturia, a thick, reddish sediment, and a large amount of pus. Four days later he was removed to Presbyterian Hospital, where he remained under treatment for four weeks, during which time he had recurrent attacks of renal colic lasting from three to ten hours every other day. The hæmaturia disappeared after five days, but the urine contained large amounts of pus, varying from half an ounce to two ounces to the pint of urine, phosphates in abundance, no uric acid, no casts, no sugar.

November 20, the patient consulted Professor Martin, who could detect no marked tumor in the region of the kidney, but considered that there was probably a calculus impacted in the ureter and advised patient to go home, rest, and adhere strictly to diet and flushing. At this time he was emaciated, anæmic, and had sustained a diminution in weight from 148 to 130 pounds.

The patient then returned to his home in Milwaukee and placed himself under the care of Dr. I. Mendel. Under enforced rest and rigid diet the pus in the urine slightly decreased during the next four weeks. He then had a severe diarrhœa which persisted for six weeks, whereby his weight was reduced to 120 pounds, and he was in a wretched condition of body and mind.

On February 1, 1894, he returned to Philadelphia and entered Presbyterian Hospital, in the service of Drs. Musser and Martin. He steadily improved, gained in strength and weight, but the pus in the urine increased in amount.

March 8 he had a severe attack of renal colic, which persisted for three days. The patient suffered intense pain; temperature 101° to 104° F.; pulse 110 to 140; had a large, hard tumor on the right side.

On March 11, Dr. Martin made a lumbar nephrotomy, with the idea of removing the kidney if it should prove to be tuberculous, and of securing drainage through the fistula if tuberculosis did not exist. The operation occupied twelve minutes. The lower two-thirds of

the kidney was found to be dilated and the large sac contained about two pints of urine and pus. The upper third of the kidney contained good secreting tissue. No calculi were found, no tuberculosis. The patient's condition did not warrant prolonged manipulation or search for the ureter.

For the first eight days no urine passed from the right kidney to the bladder, but for ten days thereafter the right ureter was patent, as was proven by the presence of pyoktanin, which had been injected into the fistula, in urine passed by way of the bladder. The ureter then closed and its patency could not be re-established. Three weeks after the operation a large number of small, well-formed calculi, about the size of No. 6 shot, aggregating about 250, were passed through the fistula. The patient wore a silver urinal and passed through the bladder about thirty ounces of urine in the twenty-four hours.

On June 22, the patient came to Chicago, and in August I examined him, and he entered Passavant Memorial Hospital preparatory to operation for obstruction of the right ureter, presumably from calculus at the pelvic orifice.

First Operation.—September 17 I operated in the following manner: Ether was administered by Dr. S. C. Stanton. The granulation tissue at the fistulous opening was removed with the sharp spoon. An incision was then made in the lumbar region through the fistula downward and forward through the skin, fascia, abdominal muscles, quadratus lumborum, and transversalis fascia. The perirenal fat which presented in the wound was separated by forceps from the anterior and inferior surface of the kidney, which was thus laid bare. The incision was prolonged downward two inches. The surface of the kidney was normal in color, the kidney enlarged and lobulated. The adhesions were slight and were easily broken up. The pelvis was now laid bare and found to be dilated. Search for the ureter was now made and it was recognized below its pelvic origin. The pulsation of the renal artery could be felt in front of the ureter. The ureter was now exposed for about an inch and a half from the pelvis. An aspirator needle was introduced into the dilated pelvis of the kidney and thin, bloody fluid withdrawn. The pelvis was now opened on its posterior surface, the contained fluid evacuated, the wound thoroughly flushed with warm, sterilized water and sponged dry.

A futile attempt was made to locate the pelvic orifice of the ureter from the pelvis. A small depression, however, was noticed, which was later shown to indicate the point of entrance.

A longitudinal incision was now made in the ureter about an inch from the pelvis, below the stricture; a flexible sound introduced through this incision passed easily down into the bladder. The lower portion of the ureter was somewhat contracted from disuse. A silver uterine probe was next introduced through the incision and passed upward; the location of the stricture was thus found to be at the point where the ureter emerges to form the pelvis. With considerable difficulty a fine, silver probe could now be pushed through the stricture into the pelvis. With the probe as a director a longitudinal incision was now made through the stenosed portion of the ureter between the two openings. The upper and lower borders of the wound were brought together by silk sutures, thus folding the ureter upon the pelvis, as described in a previous article.

The small, longitudinal opening in the ureter was left unsutured.

Before closing the wound in the pelvis an incision was made through the convex outer border of the kidney into the dilated calyces, and the upper end of a flexible bougie, which had been previously passed down into the ureter through the opening in the pelvis, was passed up from the pelvis through the convex surface of the kidney and out of the lumbar wound, to remain twenty-four hours, and then be removed. A piece of kidney tissue was also removed for examination. Hæmorrhage was controlled by the Paquelin cautery.

Early in the operation, while a digital exploration of the old sinus was being made, a small piece of rubber drainage-tube, left in at the time of the first operation and evidently forgotten, was removed.

The kidney was thoroughly explored for stones, but only one small calculus, four millimetres in diameter, was found and removed.

Drainage-tubes were inserted in both openings on the convex surface of the kidney and one in the bottom of the wound, the perirenal space, and around these gauze was loosely packed. The external wound was closed by uniting the transversalis and internal oblique, and then the external oblique muscle by interrupted silk sutures, and then the skin and superficial fascia by a continuous silk suture. Time of operation, two hours and a quarter.

Microscopic examination of the piece of kidney tissue cut out through the entire thickness of the convex surface of the kidney to its inner surface shows the following: On the inner surface nearest the calyces is a brim of young granulation tissue in which here and

there a straight canal and a glomerulus is seen. This brim forms one-third of the thickness of the kidney wall and terminates in a rather sharply defined line. The remaining two-thirds of the kidney wall from this point to the convex surface shows almost perfectly healthy kidney tissue.

The epithelium in the straight and convoluted tubules is everywhere present and almost normal. A somewhat granular appearance is present, which is probably due to the preparation of the specimen, as another specimen shows normal epithelium. The glomeruli are mostly normal, and only here and there is seen a small island of embryonal cells (interstitial nephritis). This would tend to show that at least two-thirds of the kidney tissue is available for secretory function, and this corresponds well with the twenty-five ounces of urine excreted in the twenty-four hours through the lumbar fistula.

The patient made a good recovery from the operation, but the fistula persisted, and all the urine from the right kidney passed out through the lumbar wound. He returned to his home in Milwaukee, but made monthly visits to Chicago for examination by me and urinalysis by Dr. C. W. Purdy. Marked improvement in the size of the kidney and in the quality of the urine occurred. From twenty-five to thirty ounces of urine were passed through the fistula in the twenty-four hours.

On November 30, the patient had gained thirty pounds in weight, had no pain, passed through the fistula twenty-five to thirty-five ounces of urine, and through the bladder eighteen to twenty ounces of urine daily. Pus was present in the urine, but in small amount only. The patient's general health was excellent. He had an enormous appetite, and, as he said, "would not know anything was the matter were it not for the fistula."

January 22, 1895, the patient had a sudden attack of colic on the left side, accompanied by hæmaturia and pyuria. This was entirely unexpected, as the left kidney had up to this time been regarded as healthy. This new development, of course, rendered extirpation of the right kidney out of the question. This attack lasted for two weeks. The patient came immediately to Chicago, and re-entered the hospital. The symptoms yielded to therapeutic measures, and the patient's condition materially improved.

On March 19, Dr. Purdy made the following analysis of urine from the right and left kidney:

Right Kidney.—Color, milky; specific gravity, 1010; reaction, slightly acid; quantity in twenty-four hours, twenty-five ounces;

urea, two and a half grammes per ounce; total urea, 494½ grammes; albumen, 6 per cent. bulk measure; sugar, absent; casts, none; pus, 1 per cent. bulk measure; blood, none; bacteria, none.

Left Kidney.—Color, normal; specific gravity, 1020; reaction, strongly acid; quantity in twenty-four hours, forty-three ounces; urea, eleven and a half grammes per ounce; albumen, trace; sugar, absent; casts, none; pus, small amount; blood, none; bacteria, none.

Remarks Prior to my Second Operation.—I had seen at the time of the previous operation that the condition was one of sacculated kidney, and had opened three or four of the sacs, which varied in size from a walnut to that of a hen's egg, from the surface of the kidney. These sacs I found to be filled with pus, and in one of them I discovered a small calculus.

I had opened the slightly-dilated pelvis from behind in order to look into it, but could neither see nor find the pelvic orifice of the ureter. I could see a small depression, but, as there was a very narrow stenosis, could not pass a probe down into the ureter.

I had opened the ureter by a longitudinal incision one inch below the pelvis, and passed a probe through this incision up to the pelvis, finding at the entrance a narrow stenosis, almost a complete occlusion; the lumen at this point was from one-half to one millimetre in diameter.

I had performed my plastic operation for stenosis as described in the *Journal of the American Medical Association*, March 10, 1894, Case II and figures, page 26. I had left the small longitudinal opening in the ureter to heal without suture.

I had brought out an elastic bougie passed into the ureter through the opening in the pelvis and out through an opening in the convex surface of the kidney, and this bougie remained *in situ* for two days.

After the operation, blood, pus, and injection fluid passed into the bladder for a short time only; later on all the urine passed out through the renal fistula.

The lack of success of the operation may have been caused by the failure to make a sufficiently large opening at the pelvic entrance of the ureter. This failure may have been due to cicatricial contraction around the upper end of the ureter from con-

nective-tissue masses surrounding the seat of the former incision in the pelvis and the stricture of the ureter, or to the fact that the sutures did not hold, and the opened stenosis of the ureter together with the incision into the ureter through the stricture hung down after the sutures gave way, and by retraction of the cicatrix the stricture formed again, as the folding of the ureter upon the pelvis would then, of course, have been again undone.

A second cause might have been in the kidney itself. The arrangements of the sacs with narrow entrance openings (see Fig. 4, *a*), often not wide enough to allow the passage of a finger or a urethral sound, and in addition valvular arrangements of the separation walls between the sacs, such as I described more than twenty years ago in a case of partial hydronephrosis.[1]

This condition, if the ureter was patent, would permit the urine and pus from the kidney below the valve to pass through the fistula, and only the urine and pus above the valve to pass down into the bladder. (See Fig. 5.)

Plan of Operating.—In order to guard against insufficient communication between, and evacuation of, the sacs into the pelvis of the kidney, I proposed to open the narrow entrances to the sacs,—that is, to transform the multilocular sacculated kidney into a unilocular sac with free evacuation into the pelvis of the kidney. This would have to be done from the convex surface of the kidney by opening the sacs one by one until all were transformed, so that a cross-section of each sac would show the opening of the sac to have a diameter equivalent to that of the sac at its centre. In other words, to transform each sac into a semi-sphere. (See Fig. 4, *b*.) This was especially necessary for the sacs situated in the lower third of the kidney, where, as I had previously found in an operation for stone in the kidney, the body of the sac is dependent from the lower end of the pelvis and the narrow entrance high up, the sac being flask-shaped. In the case referred to the sac contained stones small enough to pass out through the opening, had the position of the sac allowed. The stones, however, remained in the sac because the patient was never inverted for any length of time. My plan was therefore to

[1] Fenger, Op. cit.

open all the dilated calyces, even if it should prove necessary to bisect the kidney,—that is, to divide it longitudinally into two halves down to or into the renal pelvis.

If the stenosis of the ureter at its pelvic orifice had reformed,—that is, if the stricture had contracted, or if valve-formation from cicatricial, extra-ureteral contraction had taken place,—I proposed to repeat my former plastic operation for stricture or valve-formation, or to resect the stricture and implant the unfolded upper end of the ureter in the pelvis by Küster's method.

The patient's symptoms for the previous six months appeared to me to indicate that the ureter was patent, although the patency might be imperfect, and that the localized hinderance to the exit of urine was in the kidney or the pelvis above the ureter.

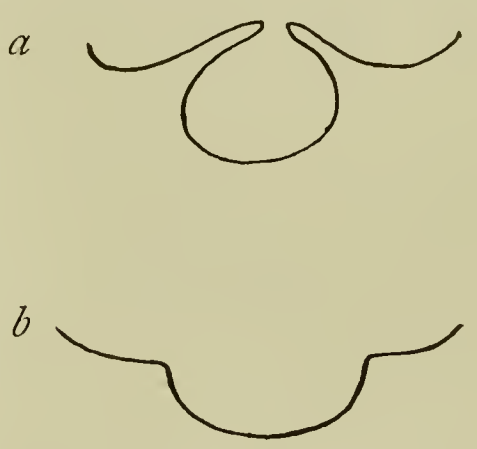


FIG. 4.—Shape of sac before and after division of partition wall (diagrammatic).

Second Operation.—On April 13, 1895, I operated at the Passavant Memorial Hospital in the presence of the doctors from the Polyclinic, and with the assistance of Drs. Brown, Brougham, and Bluthardt; Dr. Waters administered the ether. The patient was placed on the left side with a cushion under the left loin. After the granulations around the fistula had been scraped off, an incision five inches long was made through the fistula and the old cicatrix down into the sacculated kidney. The kidney was loosened from the cicatrix and the abdominal muscles down along its posterior surface until the pelvis of the kidney was reached. I now searched for the ureter, but after half an hour or more was unable to find it. I therefore determined to first bisect the kidney down into the pelvis and search for the ureter from within the pelvis.

I now proceeded to bisect the kidney and operate upon the calyces in the following manner: I first made a longitudinal incision from the opening at *A*, Fig. 5, downward and upward on the middle of the convex surface of the kidney. By so doing I opened a cavity whose wall was composed of friable kidney tissue, three or four millimetres in thickness on the convexity of the sacs, and eight to ten millimetres in thickness in the partition walls between the sacs, the wall becoming thinner again near the entrance to the sacs. This

kidney tissue bled profusely, and there was abundant arterial hæmorrhage from the vessels in the partition walls. The kidney tissue was seared and the partition walls divided with the Paquelin cautery, which stopped the hæmorrhage from the small vessels. The spurting from the larger arteries, however, was so violent that I was obliged to clamp with forceps and ligate many of the thicker partition walls step by step with catgut mass ligatures. The openings to some of the sacs were large, but others were so small as to permit the passage of my little finger-tip only.

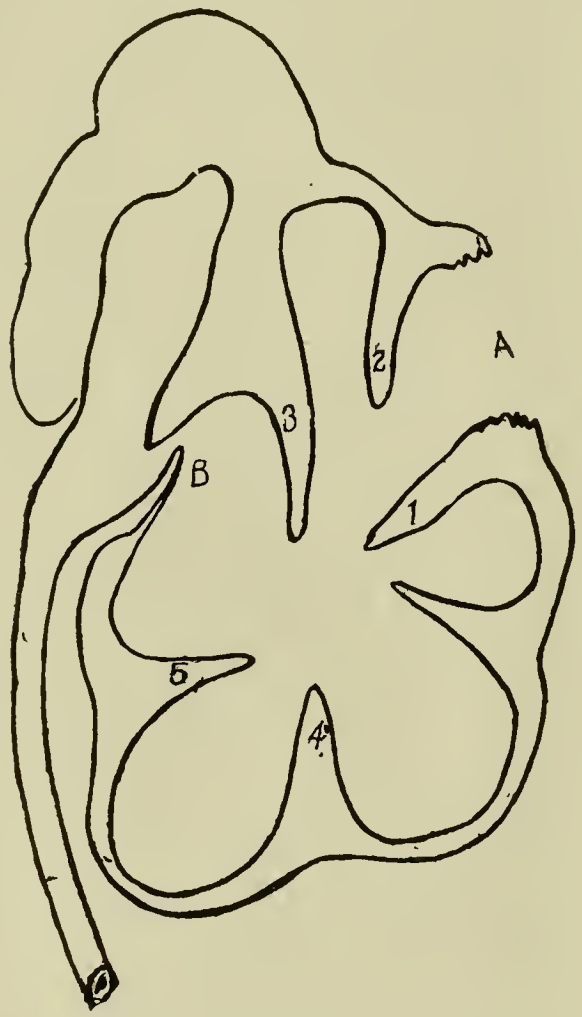


FIG. 5.—Sacculated kidney, Case I. (Diagrammatic.)

After having thus divided partitions *1*, *2*, *3*, *4*, and *5*, I believed that I had reached the pelvis, as I found a narrow opening at *B*, which I thought might lead down into the ureter; but I was unable to pass down either a silver probe or an elastic bougie. I now began a second search for the ureter from below the kidney. By blunt dissection I worked downward towards the outer wall of the renal pelvis, and came upon the vermiform appendix extraperitoneally. The appendix was as thick as a lead-pencil. I finally found the ureter and isolated it for one to two inches below the kidney. The pelvis was cone-shaped and was not much dilated. Upon making traction on the ureter I could detect no movement in what I had supposed from above to be the pelvis, nor could I pass a sound or bougie through the opening at *B* down into the ureter. This opening was so small that it would not permit the passage of the end of my little finger, but a probe passed down through it into a wider space below. I now dilated the opening with a large artery forceps until I could pass my little finger down into the cavity, which was one inch deep in a medial direction and two inches long laterally and upward.

I then divided the partition walls on Kocher's sound with the Paquelin cautery and passed mass ligatures to control the hæmorrhage from the arteries. The pelvis was now open. The wall was whitish,

in contrast to the reddish wall of the calyces. The mucous membrane on part of the wall was thickened and covered with small, flat warty excrescences (état mamelonné).

The opening into the ureter was visible, and the ureter patent. A silver probe and elastic bougies, Nos. 16 to 20, easily passed down into the bladder. This showed conclusively that the former operation for stricture of the ureter had been entirely successful as far as the re-establishment of the patency of the ureter was concerned. I could now pass an olive-pointed bougie easily down into the ureter along the posterior and the two lateral walls of the pelvis, but on the anterior wall, corresponding to the band encountered in the previous operation, a transverse fold arrested the end of the bougie. Thus in order to make the entrance to the ureter still more funnel-shaped I made a plastic operation,—that is, incision with transverse union of the wound, on the anterior and posterior borders of the ureteral opening. I now inserted an elastic bougie, No. 16, to remain for twenty-four hours.

After inserting a rubber drain surrounded by sterile gauze in the kidney I proceeded to close the wound. I partially sutured the wound on the convex surface of the kidney, leaving a large opening for drainage. I then packed gauze on the medial side, below and on the lateral side of the kidney, united the divided muscles by buried catgut sutures, and finally united the external wound with silk.

Towards the end of the operation the pulse became weak, but was slow, and camphorated oil was twice injected.

The operation lasted two hours and a half. Considerable hæmorrhage continued in spite of the Paquelin cautery and mass ligatures. In future, in a similar case, I should stop the hæmorrhage by continuous suture of the wounds in the partition walls.

Four hours after the operation the patient was awake, the body warm, pulse 150, weak, nose cool. Nine hours after the operation the patient was awake, could speak strongly and clearly, said he felt better and less weak than four hours previously. Pulse 150, weak, not much pain excepting on vomiting, when he felt pain in the wound. Considerable bloody fluid soaked through the dressing onto the bed. The patient lay on his right side. I did not consider that he was losing too much blood because the conjunctiva and lips were red, the feet cool, but he had only a sheet over them, and he was not restless. Whiskey and milk were now injected into the rectum. The patient had not yet passed water. He had had a subcutaneous injection

of strychnine. The shock was considerable and the hæmorrhage profuse, the latter because the kidney tissue was healthy.

The cause of the passage of all or almost all of the urine through the fistula lay not in the ureter or the pelvis, but in the kidney itself, in the sacs with valvular arrangements of their partition walls and narrow openings into the sacs, and also in the valve-formation in the lower branch of the ureter at *B*, Fig. 5. This caused much dilatation in the territory of the lower branch due to valvular obstruction of this territory,—namely, the lower two-thirds of the kidney, while only slight dilatation of the territory of the upper branch was present because this was dilated only from the stenosis in the ureter.

After-Treatment.—April 14. The patient urinated once, passing eight ounces of urine, slightly colored with blood. Nausea still continued and stimulant enemata were frequently repeated. The kidney was irrigated with boric acid solution.

April 15. During the night the patient experienced a strong desire to urinate, with a sensation along the ureter as if urine were passing into the bladder. He could not urinate, but five ounces of urine were withdrawn with a catheter. In the morning the patient passed ten ounces of urine, and from this time on no bloody urine was passed. The dressings were saturated with slightly bloody urine. The permanent bougie was removed from the ureter and one strip of gauze around the drainage-tube was removed.

April 16. The patient complained of great soreness, and movements of the body were painful and difficult. All the gauze drains were removed; their removal was attended by excruciating pain. The wound was irrigated and a light gauze packing introduced.

April 17. Dressings saturated with urine and very offensive pus. The offensive discharge came entirely from the drainage-tube in the kidney. The wound was dressed again in the evening, and at this time and for the next two days the discharge of offensive pus was profuse.

April 20. The discharge of pus was still profuse, but less offensive in odor. The drainage-tube in the pelvis and the stitches were removed. The patient felt stronger and the appetite increased.

The offensive odor emanating from the wound persisted until the time of the next operation, August 7. The offensive odor and discharge were attributed to infection from the catgut sutures in the kidney.

Six weeks after the operation, in order to test the patency of the ureter, I introduced a small filiform elastic bougie through the lumbar fistula into the pelvis and down through the ureter into the bladder. This procedure I repeated every second or third day, allowing the sound to remain from half an hour to an hour, gradually increasing the size of the bougie until finally a No. 5 English olive-pointed bougie was used. After each dilatation, and sometimes from twenty-four to forty-eight hours thereafter, pus and urine passed through the ureter into the bladder. This systematic dilatation of the ureter was carried on for three months. At the end of this time about one-eighth of the urine from the right kidney passed down through the ureter and about seven-eighths were discharged from the lumbar wound and the sinuses which had formed along the line of incision in the lumbar region.

On August 7, Dr. Buffum examined a specimen of urine from the bladder, which was supposed to contain some of the urine from the right kidney, and made the following report:

Specific gravity 1014; sediment, flocculent; albumen, trace; blood, a few red corpuscles; pus, large quantity; epithelium, a few columnar cells.

In a specimen of pus taken from the fistula at the same time, Dr. Buffum found the bacillus pyocyaneus. During this time the patient's condition was fairly good considering his long residence in the hospital, the great discomfort and pain in the wound, and the depression incident upon the hot weather.

As there seemed little prospect of a change, I decided upon operating for the closure of the fistula by reunion of the bisected kidney, and for the division of any partition walls that might have been left at the time of the previous operation.

Third Operation.—On August 17 I operated in the following manner: The patient was anæsthetized with A.-C.-E. mixture. The anæsthesia was difficult and the patient vomited during the operation. The granulations in the wall of the fistula were first scraped off and an incision then made through the cicatrix into the kidney. Inspection of the bisected kidney showed that three sacs containing pus and urine still remained. Two sacs were successively opened and divided with the Paquelin cautery, which was also employed to check the hæmorrhage. Only one large vessel required ligature. A flexible bougie, No. 7, French, could now be passed down with some difficulty into the ureter.

In order to unite the bisected kidney, the dense adhesions to

the abdominal wall were separated. While thus isolating the organ, a third sac was opened. This sac had evidently entirely closed and the contained fluid was under considerable pressure, for when a small incision was made in its wall, a jet of pure urine spurted out, and foul-smelling pus afterwards flowed slowly from the opening. After free division of the partition wall, and thorough irrigation, the separation of the kidney from its adhesions was completed. The kidney was now united with fine catgut with the exception of an opening one-half a centimetre in diameter for an elastic bougie passed into the ureter to remain for twenty-four hours, and an opening for a small drainage-tube in the kidney.

The wound was closed and dressed in the usual manner. The operation lasted an hour and a half; the shock was severe. The patient had severe nausea, but no vomiting after the operation until the fourth day.

August 21. Accumulation of mucus in the throat caused slight vomiting, which brought on a slight hæmorrhage from the wound and caused the superficial stitches to tear out, and also, as I afterwards discovered, caused the stitches on the convex surface of the kidney to tear out, leaving an anterior fistula which remained open until November 30.

The gauze drain was removed at the time of the first dressing and the bougie was withdrawn from the ureter at the same time. The wound was thoroughly irrigated with boric acid as in the previous operation, and for the first two weeks and a half a considerable discharge of *débris*, urine, and offensive pus was brought out with the irrigating fluid. The offensive odor gradually decreased until in the third week it entirely disappeared. From this time on the irrigation showed a marked decrease in pus, and at the end of the fifth week the urine was apparently aseptic.

On September 17, after many unsuccessful attempts to pass a bougie into the ureter, William Kessler succeeded in passing a No. 10 French with the greatest ease. The ureter was sounded every day thereafter, and as a result about three-fourths of the urine now passed down through the ureter into the bladder. The drainage-tube remaining in the pelvis was now withdrawn and the fistula allowed to close.

October 3. No distention of the kidney could be felt upon pressure, but there was still a slight discharge of pus from the fistula. About seven-eighths of the urine at this time passed into the bladder. The patient's general health was good, and his condition much im-

proved since the last operation. The quantity of urine discharged through the lumbar opening rapidly diminished, and on November 30 the wound and fistula closed.

From this time on the patient had excellent health until January 3, 1896, when, as a result of excessive drinking at Christmas time, he had a sudden violent attack of colicky pains in the region of the right kidney, with reflected pain down Poupart's ligament into the right testicle. The pain steadily continued for seven hours, when it became necessary to administer morphine hypodermically. At one point in the cicatrix there was extreme tenderness which increased day by day until an abscess finally opened. The urine passed during the night of the attack appeared normal, but on the next morning it changed to a murky, dark chocolate color, with a marked fetid odor, and, upon examination, was found to contain large quantities of pus. The urine showed these characteristics for a few days, there being sometimes three ounces of pus in twelve ounces of urine. After this time the pus decreased and the urine improved in character and color. On the second day after the attack the patient came to Chicago and consulted me. On the same night the abscess opened spontaneously with great relief to him. A drainage-tube was inserted. The bladder was filled with boric acid solution through the kidney opening, thus demonstrating the patency of the ureter. From this time on the symptoms gradually decreased, the pus soon disappeared, and on January 15 the fistula finally closed. The patient has been perfectly well up to the present time, April 10.

On April 22, I received the following report from the patient: Since January 15 no interference or treatment of any kind, and even under pressure of constant work since February 1, I have never experienced better health or greater strength. Appetite excellent; sleep sound; physically stronger than ever; wound occasions not even the slighest inconvenience; kidney exhibits no symptoms of pain whatsoever, neither in rest nor during greatest exertion, such as running up or down four or five long flights of stairs. Right side feels as sound as left. I am careful of the existing hernia in the anterior and lower part of the incision on the right side. Weight 155 pounds, stripped. Uranalysis made by Charles H. Miller shows the following: Quantity 1700 cubic centimetres; reaction, acid; clear; specific gravity, 1016; total solids, forty-eight grammes; sugar, absent; albumen, two grammes daily; blood and bile, absent; urea, 22.1 grammes daily.

Remarks.—The course of the development of the stenosis in this case is quite clear. The ascending pyelitis in the right ureter caused moderate incomplete retention and unilateral dilatation of the pelvis with valve-formation and oblique insertion of the ureter. The inflammation in the pelvis caused the stricture in the upper end of the ureter, a condition which has been so often observed as a complication with valve-formation in infected cases. On account of this condition, further retention and moderate dilatation of the pelvis, or rather of both branches of the ureter, took place. Then followed unilateral dilatation and valve-formation in the lower branch of the ureter which resulted in local cystonephrosis (pyonephrosis) of the lower half or two-thirds of the kidney. During the development of this condition, unilateral dilatation and valve-formation of the necks of three or more calyces took place with absolute occlusion of one calyx.

General Plan of Operating for Cystonephrosis.—(*a*) The general plan of operating for pyonephrosis should first take into consideration the dangers from infection. Thus, opening and drainage of the dilated kidney should first be done to evacuate the pus, and then the pyelitis should be treated locally through the drainage-tube. I always make the nephrotomy from the lumbar region, as Küster advises, because this is so much safer than the transperitoneal operation.

It is ordinarily impossible at this time to find or remedy the obstruction, unless renal calculi are present as the cause of retention. On account of the sepsis, a prolonged search for obstruction of the ureter other than stone cannot be borne by the patient.

(*b*) In cases of hydronephrosis, when the patient's condition will admit of a prolonged operation, it is usually impossible to find the orifice of the ureter in the large sac, and it is impossible to find the ureter outside of or below the sac, because the latter fills the large pelvis and covers the ureter. We must therefore wait for two or three months until the sac has retracted, or, in pyonephrosis, until the septic absorption has disappeared and the sac diminished in size, before further operating for the obstruction can be done.

If the obstructed kidney has still some secreting value, and

if the other kidney is diseased, nephrectomy becomes out of the question. While primary nephrectomy in pyonephrosis, according to Tuffier, has a mortality of 37 per cent., it has been found that in 40 per cent. of the fatal cases death resulted from disease of the other kidney. Although Israel[1] has made a successful nephrectomy on a patient whose other kidney was the seat of pyelitis, we must consider such a case as a rare exception which does not alter the rule not to extirpate a kidney whose fellow is not healthy. In the case just reported I considered nephrectomy absolutely out of the question after the attack of pyelitis and colic in the left kidney.

The importance of extirpation of a piece of kidney tissue during nephrotomy for microscopic examination is well illustrated in Case I. The specimen removed in this case showed large territories of almost perfectly healthy kidney tissue with glomeruli and epithelium in the canals, with only a few islands of disseminated interstitial granulation tissue. It is likely that this nephritis stops during the local treatment of the pyelitis through the lumbar wound, and that what is left of the kidney tissue remains useful.

If some of the urine passes into the bladder we would probably underestimate the secretory value of the kidney if we came to this conclusion from the quantity of urine passed through the fistula alone, and here microscopic examination of the kidney tissue may be valuable.

As soon as the condition of the patient permits, search for the obstruction should be made. I have already discussed the operation for obstruction in the ureter in an earlier paper,[2] and shall detail a case later to illustrate conservative operation in hydronephrosis.

Operation for Obstruction above the Ureter.—Up to this time no systematic operation, planned beforehand, has been made for this condition.

Küster[3] mentions in his paper that he attempts to transform

[1] Israel, Erfahrungen über Nierenchirurgie, Langenbeck's Archiv für klinische Chirurgie, Band XLVI, Heft 2, p. 344, 1894.

[2] Fenger, Operation for valve-formation, loc. cit.

[3] Küster, Loc. cit.

the multilocular into a unilocular sac by breaking down the partition walls with the fingers, or by dividing them with a blunt-pointed knife introduced into the sac, evidently without the aid of the eye. This operation is probably sufficient for those cases of pyonephrosis in which little or no secreting kidney tissue remains and in which obliteration of the sac is the object to be attained.

An entirely different operation, however, is required in those cases where considerable kidney tissue remains, and where the object is to restore to a useful kidney its normal function.

What is the reason that in some cases the obstruction causes dilatation of the pelvis and kidney, terminating in a unilocular sac with little or no traces of calyces, but only flat semilunar bands on the wall, and in other cases a sacculated kidney, with narrow necks or entrances to multiple dilated calyces,—that is, a system of narrow-necked sacs surrounding a moderately dilated pelvis? The cause of this difference is not known, but it seems to me that dilatation of the calyces into sacs with narrow necks is more common in cases of retention with early infection than in cases of retention infected later or not at all (hydronephrosis). The intensity of the infection—the inflammation—is apparently a potent factor. It may be that the inflammation causes thickening of the pelvis and necks of the calyces where the mucosa is provided with a considerable layer of submucous connective tissue, and even with muscular layers capable of inflammatory thickening followed, if not by retraction, at least by resistance against dilatation. The papilla, meanwhile,—that is, the kidney tissue proper, the tissue of the pyramids with thin mucosa and no submucous tissue or muscularis,—does not form a sufficiently thick layer of inflammatory connective tissue to protect against dilatation. If this be correct, it explains the formation of a comparatively small pelvis and of largely dilated calyces, having narrow necks, formed by the papillary portion of the calyx.

An operation to restore the function of a sacculated kidney must have for its object the overcoming of the obstruction in the three places I have already described. Obstruction in the pelvic end of the ureter and in one or more calyces is often found, while the local cystonephrosis is rarely encountered. Occlusion

at the necks of the calyces is probably met with a greater degree of frequency, proportionate to the relation between the number of the calyces and the number of branches of the pelvis.

The operation must begin with bisection of the kidney from its convex surface down to the pelvis. The characteristic features of this operation, which I have termed "operation for sacculated kidney" in contradistinction to nephrotomy, are the treatment of the bisected kidney, the division of all partition walls between the dilated calyces and the finding of all the calyces, some of which may be very difficult to detect.

This operation must be done with full view of, and free access to, the inner surfaces of the bisected kidney. The hæmorrhage varies considerably in proportion to the more or less normal condition of the kidney tissue. Hæmorrhage is controlled by the Paquelin cautery, mass ligatures, or continuous suture along the divided partition walls, together with digital compression of the renal artery by an assistant. It will be impossible to find the calyces, which often have a narrow entrance, to divide all the partition walls, to check the hæmorrhage, to examine the pelvis, and to remedy folds or valve-formation unless we have ready access to the whole interior of the organ with eyes, hands, and instruments.

During the after-treatment I consider it important to have free access to the ureter for the introduction of bougies every day or two when irrigation is made.

Finally, after months of local treatment, when the pyelitis has subsided and the ureter is patent, the bisected kidney should be reunited after the two halves have been loosened from the abdominal wall. Catgut is probably preferable to silk as a suture material in this procedure. When the ureter is patent, when all the calyces have been laid open and the two halves of the kidney have been reunited, the fistula will always close.

Scope of the Operation.—I am well aware that the operation for cystonephrosis proposed by me has a comparatively narrow field in the mass of cases of pyo- or hydronephrosis. It is not intended that it should replace nephrectomy altogether, nor that it should be employed after nephrotomy in all cases. Each of these three operations has its own legitimate field.

(*a*) *Infected Cystonephrosis* (*Pyonephrosis*).—In infected sacculated kidney, primary nephrectomy is rarely indicated, and in this respect I fully agree with Küster; but although nephrotomy, opening, and drainage is the operation of choice, and should be the first operation in the great majority of cases, we may encounter a kidney with multiple abscesses in the kidney substance,—surgical kidney,—in which case primary nephrectomy would be the only means of stopping a sepsis immediately dangerous to life.

(1) *Primary nephrectomy* for pyonephrosis has a mortality as given in the statistics of various observers as follows: Tuffier reports sixty-seven cases, with a mortality of 38 per cent.; Brodeur reports fifty-eight deaths out of 128 cases, a mortality of 46.7 per cent.; von Bergmann reports thirty-two deaths in seventy-three cases, a mortality of 43.9 per cent.; and Israel, in nineteen cases reports a mortality of 21 per cent.

(2) *Secondary nephrectomy*, whether performed early or late, may become an immediate necessity when nephrotomy is followed by persistence or increase of the septic symptoms from additional microbic invasion, leading to the same condition of multiple septic foci in the kidney substance proper.

Tuffier reports twenty-four cases of secondary nephrectomy with two deaths, a mortality of 5.9 per cent.; von Bergmann reports a mortality of 9.3 per cent.; and Israel reports four cases with three deaths, a mortality of 75 per cent. The striking difference in the mortality-rate is undoubtedly due, in part at least, to the fallacy attendant upon statistics from a small number of cases.

(3) *Nephrotomy*.—Franz Ris[1] states that general rules governing the choice between nephrectomy and nephrotomy in pyonephrosis cannot be formulated. It is necessary to individualize. Nephrectomy, he says, is rarely called for, but "nephrotomy in simple (non-tuberculous) pyonephrosis is to be defended also in the cases where the chances for life by extirpation are favorable."

In a large number of cases nephrotomy effects a cure

[1] Ris, Zur Nierenchirurgie; P. Bruns's Beiträge, Band VII, Heft 1, p. 164.

(Küster). The fistula closes, either because the ureter becomes patent from retraction of the sac and spontaneous disappearance of the oblique insertion and valve-formation, or because a sac which has no secretory kidney tissue remaining shrinks and becomes obliterated like a drained abscess. Thus in all cases where nephrotomy is followed by cure,—that is, in which urinary fistula does not persist, further operation is not called for.

The statistics of nephrotomy in pyonephrosis show a mortality in the cases reported by Tuffier of 33 per cent. in calculous, and of 23 per cent. in non-calculous pyonephrosis; von Bergmann reports twenty-two deaths out of seventy-two cases, a mortality of 30.5 per cent.; Küster, one death out of thirteen cases, a mortality of 7.7 per cent.; and Israel two deaths out of thirteen cases, a mortality of 15.4 per cent.

How often further operation is called for, how many permanent fistulas remain, and how many kidneys secrete a sufficient quantity of urine to be of value to the patient I am unable to say, but the statistics of various observers show marked differences in these regards. Tuffier reports 34 per cent. of fistulas in calculous, and 57 per cent. in non-calculous pyonephrosis; S. W. Gross reports 29.5 per cent.; Küster, 9 per cent.; and Israel reports seven cases out of thirteen in which fistula persisted, a percentage of 53.8. The same observer reports two out of thirteen cases cured without fistula, or 15.4 per cent.

(*b*) *Non-Infected Cystonephrosis* (*Hydronephrosis*).—The statistics of primary and secondary nephrectomy and of nephrotomy in hydronephrosis are as follows: Tuffier reports twenty-six cases of nephrectomy with two deaths, a mortality of 7.7 per cent. He reports a mortality of 31 per cent. for primary, and no mortality for secondary nephrectomy. De Jong reports five deaths out of fifteen cases of primary nephrectomy, a mortality of 33.3 per cent.; and S. W. Gross eight deaths out of twenty-one cases, a mortality of 38.1 per cent.

Tuffier reports thirty-two cases of nephrotomy for hydronephrosis, with a mortality of 18 per cent.; Küster had one death in five cases, a mortality of 20 per cent. Tuffier reports 66 per cent. of fistulas, and Küster 40 per cent.

Herczel,[1] in a report from Czerny's clinic, advises, "first, nephrotomy; later, if necessary, secondary nephrectomy."

It is likely, when the above plan is followed,—that is, when primary nephrectomy is made only when sepsis renders the operation imperative,—when secondary nephrectomy in cases of copious urinary fistula is abandoned in favor of the search for and operation for stenosis in the various places in which it occurs, that the cases in which it is possible to save the kidney, which has hitherto been accomplished only when absence of the other kidney made it imperative (Küster's case of resection of the upper end of the ureter and implantation in the pelvis), will be more common than we have hitherto expected, or than can be found in the literature of the past.

I will here give a few examples from the literature of similar cases in which, it seems to me, the kidney might have been saved had this method of procedure been adopted.

Rupprecht[2] reports a case of hydronephrosis in a girl of nine years. The patient had small-pox at the age of three, and the hydronephrosis developed four years later. Nephrotomy was performed by Dr. Meusner. There was a very considerable discharge of urine through the fistula, or, as the author expresses it, she was "flooded with urine all the time." In spite of the fistula and the slowly-increasing albuminuria she felt well for years. Five years after the operation the patient died. The autopsy revealed general amyloid degeneration; the right kidney was embedded in a large cicatricial mass, and was adherent to the colon and liver. There was also cicatricial occlusion of the ureter at the place of its exit from the renal pelvis. This patient's life might have been saved had the operation for valve-formation been performed in time.

Rupprecht also reports the case of a boy of five years, who had a probably congenital, intermittent, right hydronephrosis. Aspiration evacuated boric acid with which the bladder had been washed out. Later aspiration evacuated purulent urine, probably from infection from the bladder. Abdominal nephrectomy was performed. The removed kidney was seventeen centimetres long,

[1] Herczel, P. Bruns, Beiträge zur klinischen Chirurgie, Band VI, Heft 3, p. 494.

[2] Rupprecht, Centralblatt für Gynäkologie, No. 33, 1885, p. 523.

eleven centimetres wide, and four centimetres thick, and weighed 530 grammes. The pelvis contained purulent urine. There was valve-formation and oblique insertion of the ureter, but the obstruction was not complete, as urine would pass down into the bladder upon pressure on the tumor. The patient made a good recovery from the nephrectomy, and felt well for eight months,[1] although cystitis persisted. Sudden uræmic coma and a swelling in the region of the left kidney now appeared, and the patient died two days later. The autopsy showed that the left kidney was not much changed. Three valvular folds of the mucosa of the ureter existed, which divided the ureter into four parts of widely different diameters. Regarding this case, Rupprecht remarks, " Puncture or nephrotomy might perhaps have prolonged life."

I think that nephrotomy of the right kidney and operation on the valve-formations in the ureter might have permitted the patient to bear up, notwithstanding the attack in the left kidney, long enough to permit of nephrotomy and possible operation on the valves in the ureter, which would have saved his life.

Valvular strictures of the ureter at some distance below the pelvis can be extirpated through a longitudinal incision in the ureter. I have done this successfully in a case which will shortly be published.

J. Israel[2] reports the case of a woman of twenty-one years, with intermittent right hydronephrosis, in which the tumor would disappear sometimes spontaneously, sometimes on pressure, as, for instance, during examination. After evacuation, a somewhat enlarged, movable kidney could be felt. The urine at this time was " slightly catarrhal." The intermittent pain was relieved by an elastic bandage with pad. The patient felt better during pregnancy. In the course of ten years as the pain persisted, as the tumor became more immovable, and could not be emptied as completely as before, as hæmaturia and increasing pyuria, increase in size of the tumor and permanent invalidism resulted, Israel decided to remove the kidney by lumbar nephrectomy. This was done and the patient recovered. The kidney " forms

[1] Rupprecht, Centralblatt für Gynäkologie, No. 15, 1888, p. 235.

[2] J. Israel, Op. cit., p. 553.

a large nodular (gebuckelten) sac, in its lower two-thirds the sac-wall is as thin as paper. In the upper third a rather thick layer of kidney substance remains. The pelvis of the kidney is moderately dilated and heart-shaped. In the normal position of the kidney only a small portion of the liquid contents runs off, while the greater portion stagnates in the sacculated and dilated lower portion of the kidney. This is not evacuated until the kidney is turned up into an almost horizontal position with the pelvis directed downward."

This cystonephrosis resembled in every particular the condition in the autopsy and in the case of local cystonephrosis described by me, and it seems probable that early conservative operation—that is, ten years previous—might have saved the kidney.

Rayer, in Plate XV, Fig. 2, illustrates a similar local hydronephrosis of the lower half of the left kidney in a case of nephrolithiasis.

As an instance of conservative operation for aseptic cystonephrosis (hydronephrosis), to prove that when the ureter is made patent the fistula closes or does not form, and, further, to illustrate the series of operations indicated, I report the following case:

Synopsis.—Aseptic remittent cystonephrosis in movable kidney of at least seven months' duration; intermittent hydronephrosis with evacuation of clear urine; pain; lumbar nephrotomy; ureter not to be found; packing, drainage; infection of sac. Two months later retraction of sac one-half; diminution of urine through fistula from five to three ounces daily. One month later, sac considerably diminished in size. Operation for valve-formation and oblique insertion of ureter at pelvic orifice. Closure of wound and fistula in forty days.

Case II.—Mrs. C. L., aged twenty-eight years, was referred to me by Dr. G. E. Newell, of Burlington, Wis., early in August, 1894. The patient has been married four years, has one child three years of age. She was well until the birth of the child, at which time she was attended by a midwife, had a dry labor, and was much torn. For four weeks thereafter she had more or less severe pain, but at the end of this time had an attack of "inflammation of the bowels" with pain on either side of the pelvis, in the back, and down the thigh. She was in bed two weeks, but has complained more or less ever since.

In February, 1894, she first noticed a movable lump in the left side which descended towards the pelvis when the patient was erect, and was then accompanied by pains in the lumbar region, and slipped back towards the lumbar region when she lay down.

The tumor varies in size, and this variation is associated with urinary secretion. When the tumor is enlarging a relatively small amount of urine is passed, and when it decreases in size there is a very considerable increase in the amount of urine, and the urine is lighter colored and clearer than at other times.

Upon examination the tumor was felt in the left renal region, which, by ballottement, with one hand on the abdomen and the other in the lumbar region, was shown to be movable.

Operation.—On August 8, 1894, I operated in the following manner: I made an oblique lumbar incision, whereupon a lobulated, thin-walled, transparent tumor presented in the wound. Upon incision of the sac wall a quart of clear, straw-colored fluid was evacuated. The inner wall of the sac was then inspected. It was smooth, whitish-gray in color, and resembled a serous membrane, but was more velvety. Five minutes after incision and evacuation thousands of small ecchymoses appeared and oozing commenced from the now blood-red inner surface of the sac.

Upon palpation the finger could not reach either the upper or the lower end of the sac, which was shaped like an hour-glass (see Fig. 3). The lower portion of the sac was round and larger than the fist and its lower end extended down into the large pelvis. I could palpate the wall by pressure from outside of the abdominal wall with one hand in the sac, but could not find the ureteral opening. Upon inspection with direct light, sunlight, no ureter could be seen, and search for the ureteral opening with a probe was also negative. I therefore thought that the ureteral entrance was in the upper portion of the sac.

Between the upper and lower portions of the sac there was an isthmus one and a half to two and a half inches in diameter, circular, and with a sharp edge over which two or three fingers could be passed into the upper portion of the sac, but could not reach the medial or upper end. Through the anterior wall I could feel the spleen moving with respiratory movements. The posterior wall was in close proximity to the vertebral column, the anterior surface of which, together with the aorta, I could feel.

The incision opening in the lower portion of the sac was sutured

to the skin, and the remainder of the wound united with buried sutures for the muscles and sutures for the skin. The hydronephrotic cavity was packed with borated gauze and two large drains introduced, one up and one down.

The secretion from the sac gradually decreased until only four or five ounces passed through the fistula in the twenty-four hours, and she was sent to her home for further treatment. The wound was dressed every day.

On October 1, 1894, Dr. Newell sent the patient back to me for examination on account of suspected infection of the sac. Upon inspection of the sac at this time with sunlight, the wall was seen to be rose-red, velvety. The sac was somewhat retracted and could be easily palpated all over its lower portion, but after careful search no ureter could be found. The isthmus was unchanged, I could not reach the upper or medial end of the upper portion of the sac, and a sound passed up for six inches. When two fingers were introduced through the isthmus into the upper portion of the sac, its walls closed upon the fingers with the respiratory movements, and the sac walls came in contact with each other down to the isthmus, while the lower portion of the sac was distended with air.

The question of choice of operation now arose between an operation for reopening of the ureter and nephrectomy. I decided against the latter operation on account of the size of the sac. During the next five weeks the excretion of urine through the fistula diminished to three ounces.

On November 17, I operated to reopen the ureter. Palpation prior to operation showed the sac to be considerably diminished in size. I could palpate all over the surface of the lower portion of the sac, the isthmus, and the upper portion of the sac, the wall of which was smooth (état mamelonné).

I made an incision over the lower portion of the sac, through the old cicatrix and the abdominal muscles. On the anterior and lateral outer wall at the lower end of the sac I found the ureter, which was normal in size. The ureter was now partially isolated with the intention of incising it and passing a probe up through the incision into the sac, and thus determining the pelvic entrance of the ureter. On making traction on the isolated ureter outside of the sac, however, and inspection of the sac, I saw a nipple-shaped projection with a depression in its centre. Through this depression a long flexible silver uterine probe passed into the ureter and down into the bladder

without difficulty. Flexible bougies, Nos. 4, 5, and 6 passed, easily down into the bladder. This demonstrated that there was no stenosis or stricture of the ureter or ureteral opening into the pelvis, but that valve-formation or occlusion by lateral implantation of the ureter on the antero-lateral wall of the lower sac existed.

I now operated on the ureter from within the sac in the following manner: A grooved director was inserted into the ureter and the sac wall and ureter divided for three-quarters of an inch to an inch. The opened ureter was recognized, unfolded, about one centimetre broad, and its wall normal or perhaps a little thinner than normal. The divided sac wall, which was separated from the ureter by loose movable connective tissue, was resected all around, and the borders of the unfolded ureter sutured to the borders of the wall of the sac. Thus the free entrance of liquid from the sac into the ureter was positively secured.

The large opening in the sac, two inches in diameter, was now closed by sutures in the outer half of the wall, which did not take in the mucous membrane or the kidney tissue layer in the inner wall of the hydronephrotic sac. Only a small opening the size of a lead-pencil was left for drainage. The adhesions of the opening into the sac were first dissected off from the skin or from the border of the lumbar opening. Gauze was packed along the drainage-tube down to the opening in the sac, the abdominal wall united by buried and skin sutures and the usual dressings applied.

November 18. Much discharge of blood, severe pain, pulse 126, rapid, temperature 101° F., urine thick and muddy, but contains no blood.

November 19. Considerable discharge, consisting of blood with very little urine. No blood in the urine.

December 6. Gradual improvement. The patient has little or no pain. Very little discharge through the drainage-tube, no pus in the sac, some discharge of pus from the extranephritic sinus. On irrigation, when the sac is filled with fluid, pain is felt along the course of the ureter to the bladder. The first urine passed after irrigation contains bubbles of air. A solution of pyoktanin was injected into the sac and the tube plugged. In less than an hour, urine heavily stained with pyoktanin was passed.

December 16. Tube was removed from the kidney and the opening packed with gauze; no pus; very little pain. At times the patient feels a fulness in the right side, but no tumor can be felt. She has soreness in the region of the erector spinæ muscles.

December 19. Since the removal of the tube the discharge has been very slight, at times hardly staining the gauze. On removal of dressings it is usually found that the gauze has been forced out of the wound, and the opening into the sac is made with difficulty. On the introduction of a silver catheter no urine escapes from the sac. Boric acid irrigations were made daily. One ounce of boiled milk was injected into the sac and fifteen minutes later urine of milky whiteness was passed. One hour later urine of the same character was again passed.

December 20. On inserting the catheter, which was difficult on account of the small size of the opening, half a teaspoonful of milky fluid, pus or milk, or a mixture of the two, was evacuated.

December 21. Irrigation stopped. Before operation, when the sac was irrigated, the patient would only notice distention. Since the operation, she has felt, in addition to the distention, pain along the course of the ureter to the bladder.

December 22. The patient has been menstruating for the last twenty-four hours, and complains of pain extending down along the course of the right ureter. There is tenderness on pressure in the right hypochondrium. When the patient lies on the left side a tumor, tender on pressure, can be felt on the right side just below the liver, which can be pushed upward and backward.

December 26. Fistula closed. There has been no passage of air since the irrigations were discontinued. The patient passed twenty-seven ounces of urine containing seventy pus-corpuscles to the field.

The renal fistula closed on the fortieth day after operation.

December 27. Patient passed twenty-six ounces of urine containing no albumen, but a slight cloudy sediment. On microscopic examination fifty pus-corpuscles to the field were seen.

December 29. Patient urinates five to ten times in the twenty-four hours. The urine is acid, and contains no albumen, but pus-corpuscles about ten or twenty in the field.

Remarks.—The ureter ran obliquely on the antero-lateral wall of the sac for an inch and a half. There was no stenosis of the slightly atrophic ureter. The ureteral opening could not be seen or found from the inside of the sac until the ureter below the sac had been laid bare, so that the place of entrance could be seen when traction was made on the ureter.

The sac retracted slightly in the first two months after the nephrotomy, but considerable retraction took place in the third month.

The practicability of lumbar nephrectomy seems to be increased after retraction of the hydronephrotic sac. In this case this could have been done three months after the operation, as the wall of the hydronephrotic sac was only loosely connected with the surrounding tissues or organs.

I think that nephrectomy might have been safely performed in this case, as the urine was normal, and as only about three ounces was secreted in the twenty-four hours from the fistula. I decided, however, to try opening the ureter to see if this procedure would prove efficacious in closing the lumbar urinary fistula.

The case conforms to the law that a lumbar renal fistula does not persist when the ureter is patent. Whether it is worth while to save a kidney with a daily excretion of only three ounces is a question not to be decided until future observations have taught us more about the subject than we know at present,—namely, where to draw the line between a valuable and a valueless organ.

Conclusions.

Conservative surgery in cystonephrosis demands a number of successive operations:

I. *Hydronephrosis.*—(1) Lumbar nephrotomy followed by packing and aseptic drainage. If urinary fistula remains, after three months,

(2) Operation for the stenosis,—namely, for (*a*) stricture of ureter, or (*b*) valve-formation and oblique insertion. If the fistula still remains with the ureter patent, which occurs only when there is obstruction above the ureter,

(3) Operation for sacculated kidney as designed by me,—namely, bisection of the kidney and division of the partition walls between sacs. When the entire territory of the sac is thus laid open and the ureter is patent, as demonstrated by free passage of bougies from the kidney to the bladder, and by free passage of injected fluid, then

(4) Closure of the fistula by reunion of the bisected kidney. This last operation may confidently be expected to be followed by disappearance of the fistula. It should not, however, be done until the pyelitis, if present, has been cured by thorough irrigation from the kidney to the bladder. Küster observed a case of nephrotomy in which the fistula closed spontaneously, with patent ureter, but the pyelitis persisted, giving an incomplete cure. I have seen, however, that when the fistula is closed before the pus has disappeared entirely from the urine, the pus in the urine having remained unchanged in amount for a considerable time, the closure of the fistula acts as a curative measure and causes the pyelitis to cease. Is this beneficial effect on the kidney after closure of the fistula due to cessation of continued infection through the lumbar opening or to cessation of irritation of the drainage-tube, when the stenosis has been removed, as shown in my two cases reported in a former paper?

In unilocular hydronephrosis the operation for sacculated kidney is, of course, not required, and only nephrotomy, the operation for valve-formation in the ureter and that for closure of the kidney are needed.

II. *Pyonephrosis.*—(1) Lumbar nephrotomy, followed by drainage and local treatment of the pyelonephritis. When the fistula persists, when considerable healthy urine passes through it, and the kidney has retracted to a reasonable degree,—that is, in two or three months,

(2) Search for the obstruction and operation to remove it.

(*a*) Stricture of ureter and valve-formation at its pelvic entrance. If this condition with a ureter patent from pelvis to bladder, still does not prevent the passage of large quantities of urine through the lumbar fistula, obstruction above the pelvis should be suspected, and

(*b*) Operation for sacculated kidney with bisection and division of the partition walls of the calyces and of the branches of the ureter should be made. When the whole territory of secreting kidney tissue is thus in unimpeded connection with the bladder and still spontaneous closure does not take place, although the pyelitis is almost cured, the final step to effect closure of the fistula should be taken,—namely,

(3) Closure of the bisected kidney, by loosening the adhesions of its two halves to the abdominal wall and by suturing the kidney substance together.

Nephrectomy, like amputation, is a short and summary way of dealing with the diseased organ or limb. The loss of a kidney, even if half its function remain, may be more dangerous to life than the loss of an arm or a leg. At the present day we would not think of sacrificing an extremity which might be of even partial use, but kidneys have been sacrificed by hundreds, as is shown by the number of cases of primary nephrectomy in cystonephrosis (pyo- or hydronephrosis). It is impossible to estimate how many of these kidneys might have been saved by conservative operation.

Conservative operation to save a cystonephrotic kidney requires a hard struggle, many operations during a long period of time, and a great deal of energy and patience on the part of both patient and surgeon; but the case above detailed demonstrates that when this course of treatment has to be carried out, because nephrectomy would mean death, a final success can be obtained and the patient be saved from the dangers of, and the social misery attendant upon, an abundantly secreting urinary fistula.

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